SUMMARY OF MASTER'S DISSERTATION

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Title
An Economic and Environmental Optimization Model
for Household Energy-Saving Upgrades in Different Regions of Japan

Abstract

Responding to global warming problems, Japanese government has set the target to reduce CO_2 emissions by 39% in 2030 compared with 2013 in the residential sector. Therefore, it is essential to diffuse energy-saving houses, and the introduction of Photovoltaics (PV) is assumed as a residential energy-saving upgrade.

However, when PV is installed into households, the electric power company has to construct thermal power stations to deal with surplus power. Consequently, CO_2 emission increases. The implementation of household battery systems can solve this problem but causes the increase of household cost.

Therefore, in order to accelerate energy-saving upgrades, it is important to clarify how large should the capacity of battery be to achieve the lowest total cost. The total cost includes household cost, electric power company cost and government cost. The former two are from economic aspects, and the latter one is from environmental aspect of CO_2 emission. The purpose of this research is to make suggestions about the best capacity of battery where the lowest total cost can be achieved.

This research developed an economic and environmental optimization model for energy-saving upgrades in households. The requirements of multi-stakeholders (households, government and electric power companies), regional differences and equipment subsidy are included in the model, which are the originalities of this research. By inputting open data from the government into the model, the simulations of present scenario (2017), and future scenarios (2025&2030) were performed.

The simulation results of present scenario show that when PV and battery systems are installed into households, household cost decreases, but CO_2 emission and electric power company cost increase in all regions. It does not suggest installing PV or batteries.

On the other hand, the simulation results of future scenarios show that when PV and battery systems are installed into households, household cost, CO_2 emission and total cost decrease in all regions. The best capacity of battery is suggested for each region.

Key Word(5 words)
CO_2 emission, Energy Saving, Photovoltaics (PV), Battery, Simulation